

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:	)	Group Art Unit:	1771
	)		
ABRAMS	)	Examiner:	JUSKA, C.
	)		
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July 3, 2003	)		
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Atty. File No.:	)		
4811-16	)		
	)		
For: "PROCESS FOR PRINTING AND	)		
MOLDING A FLOCKED ARTICLE"	)		

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

We, Dr. Gerald T. Keep and Mr. William A. Haile, being over the age of eighteen, declare as follows:

1. A curriculum vitae for each of us is attached. Both of us were employed by Eastman Chemical Company, the only commercial producer of poly(cyclohexanedimethylene terephthalate) or PCT polymer, for a combined 51 years of service. Dr. Keep has been working with PCT polymer for 21 years, developing tens of millions of dollars of business based on PCT molding formulations. He has worked on a project attempting to heatset PCT film. He has worked with high temperature fibers and monofilaments for three and a half years at Fiber Innovation Technology. Mr. Haile worked with polyester-based fibers in a variety of ways at Eastman for 34 years, including specifically the spinning, heatsetting and end use of PCT staple fiber as well as the melt blowing of PCT filament.

2. Each of us has spent a substantial portion of our careers working with PCT polymers and copolymers, which makes us fairly unique given the more specialized usage of PCT as compared to the more commodity PET, for instance. We have worked with heatsetting of materials and know the strengths and weaknesses of PCT. We have jointly patented

improvements in PCT to improve its long-term heat-aging performance. As leading authorities on PCT polymer, we have a good grasp of how PCT compares to other high temperature fibers.

3. We would like to submit the following regarding patentability of use of PCT Flock for High Voltage Graphics:

Sublimation dye printing is commonly performed on poly(ethylene terephthalate) (PET) film and fabric substrates. There is generally nothing done commercially with PCT substrates. The same goes for the acid-modified PCTA versions.

The invention here is the novel choice of PCT (or interchangeably PCTA) flock as a substrate onto which sublimation dye printing is performed. This note is intended to illuminate the three requisite aspects of any invention – the novelty, the utility, and the non-obviousness of this invention.

Printing on flock is different from printing on film or fabrics. When PET flock is subjected to sublimation dye printing, it does not perform adequately. At temperatures the flock can withstand, the disperse dye does not achieve adequate penetration into the flock. At elevated temperatures, the flock fails under the heat, becomes harsh to the touch and loses some mechanical properties.

PCT would NOT be expected to be a better candidate than PET in this application for the following reasons:

-- While PCT has a significantly higher melt point than PET, PCT cannot be heatset to as high a degree as PET for two reasons:

i) PCT crystallizes faster in an unoriented state, and can't be drawn as much as PET, so does not develop oriented crystals as readily. Oriented crystals are generally considered the key to heatsetting of fibers, as they pin the fiber in the oriented state. Fiber tenacity is also critically dependant on oriented crystals, which come from orientation of molecular chains.

ii) PCT develops a lower percentage crystallinity than PET because it is made from a glycol of mixed stereochemistry, with approximately 30% cis-form CHDM (which depresses the melt point) for processing purposes. The end result is a lower degree of crystallinity achievable

regardless of temperature used. PCTA includes an additional amount of isophthallic acid comonomer, which simply increases this effect.

-- PCT has a lower percentage of aromatic content than PET and combined with its stereochemistry and higher melting point, should less readily accept disperse dyes.

-- PCT has a higher glass transition temperature ( $T_g$ ) and melt point ( $T_m$ ) and so would be expected to retard dye strike and penetration and thus be limited to lower-energy disperse dyes.

-- PCT has a lower modulus and so should crush more easily in the printing process.

-- PCT is more prone to discoloration and is more expensive, thus discouraging its potential development and use.

What we have found, unexpectedly, are the following surprising benefits from PCT:

-- Disperse dyes penetrate PCT very rapidly and to a high degree, giving a higher luster than PET. This enables greater selection of disperse dyes, including the low to high energy dyes, deeper shades and potential of lower cost.

-- High energy disperse dyes (higher molecular weight, less mobile, improved fastness potential) offer many positive attributes and work well with PCT.

-- The softness of the PCT flock is retained during exposure to the heat of the printing process and does not become harsh. Linear shrinkage of the fiber does not damage the desirable softness characteristics as much as expected.

-- The resiliency of the PCT flock allows greater recovery after being crushed in the printing process, with greater retention of fiber mechanical properties.

-- PCT holds an electrical charge better than PET, so less finish is needed to enhance chargeability and create flocked substrates. This is an unobvious finding, not known before.

The unbiased practitioner in the art would have expected PCT flock to shrink, become harsh and brittle, and have poor dye take-up in sublimation dye printing. Instead the inventor has been able to print on PCT flock with high resolution and deep luster, and yet retain a degree of softness not previously attainable. The inventor is the first to uncover these properties of PCT flock.

Thus, the high degree of utility of PCT flock in this application is both novel and unexpected.

#### Summary

Expectation: Poor linear fiber heatset causes harsh aesthetics

Reality: PCT remains soft on printing

Expectation: High Tg limits dye take-up

Reality: Faster strike/penetration, High Energy dyes perform well

Expectation: PCT polymer chemistry, T<sub>m</sub> & T<sub>g</sub> limits dye acceptance

Reality: Good luster & depth of shade

Expectation: Low modulus causes crushing on print

Reality: PCT resiliency is a positive benefit

Expectation: PCT and PET on charging, hold electrical charges comparably

Reality: PCT holds the charge much better, with very slow charge decay

We hereby declare that all statements made herein of our own are true and all statements made on information and belief are believed to be true; and further, that the statements were made with the knowledge that willful false statements and the like, if so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the subject application or any patent issuing thereon.

Date: May 7, 2007

By: William A. Hoile

Date: May 7, 2007

By: Gerald J. Keop